

THE TAXONOMY OF HAZARDIA (COMPOSITAE: ASTEREA)

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ABSTRACT

Hazardia is treated as a distinct genus, elevated from its most recent position as a North American section of the large genus *Haplopappus*. As such, *Hazardia* includes 13 species in three sections. The closest relatives of *Hazardia* species are probably in *Haplopappus* section *Polyphylla* of South America. Members of the North American genera *Xylorhiza* and *Machaeranthera* appear to be more distantly related to *Hazardia*.

Hazardia is a genus of 13 species of mostly woody, perennial shrubs and subshrubs distributed in California and adjacent southern Oregon, southern Nevada, and northern Baja California (Fig. 1A–C). It was first designated a genus by Greene (1887), based on *Corethrogyne cana* Gray, in honor of Barclay Hazard, a California insular botanist. The most recent monograph of *Hazardia* was by Hall (1928), who relegated it to sectional rank within the large genus *Haplopappus* and suggested its closest relationships to be with *Haplopappus* sections *Isocoma* and *Ericameria* in North America and section *Polyphylla* in South America. This treatment has been followed in several major floras (McMinn, 1951; Munz, 1959; Abrams and Ferris, 1960) and by some current taxonomists (Jackson, 1966, 1968, 1978; Moran, 1969, 1976; Cronquist, pers. comm.). However, studies subsequent to Hall's (1928) monograph of *Haplopappus* have questioned the congeneric treatment of North American sections, suggesting that they be treated as separate genera (Shinners, 1950, 1951; Keck, 1956; Anderson, 1966; Turner, 1972; Anderson et al., 1974; Urbatsch, 1975, 1978; Hartman, 1976; Mayes, 1976). In this paper I evaluate the relationships of Hall's *Haplopappus* section *Hazardia* and discuss the merits of treating it as a separate genus. I also designate three natural groups within *Hazardia* as sections.

GENERIC RELATIONSHIPS

Hall (1928) suggested close relationships among *Haplopappus* sections *Hazardia*, *Isocoma*, *Ericameria*, *Asiris*, *Isopappus*, and *Hesperodoria* in North America. However, chromosome data do not support the inclusion of *Hazardia* in this group. Most of the 13 species of *Hazardia* have a chromosome number of $n = 5$, the exceptions being *H. brickellioides* with $n = 6$ and *H. whitneyi* with $n = 4$. *Erica-*

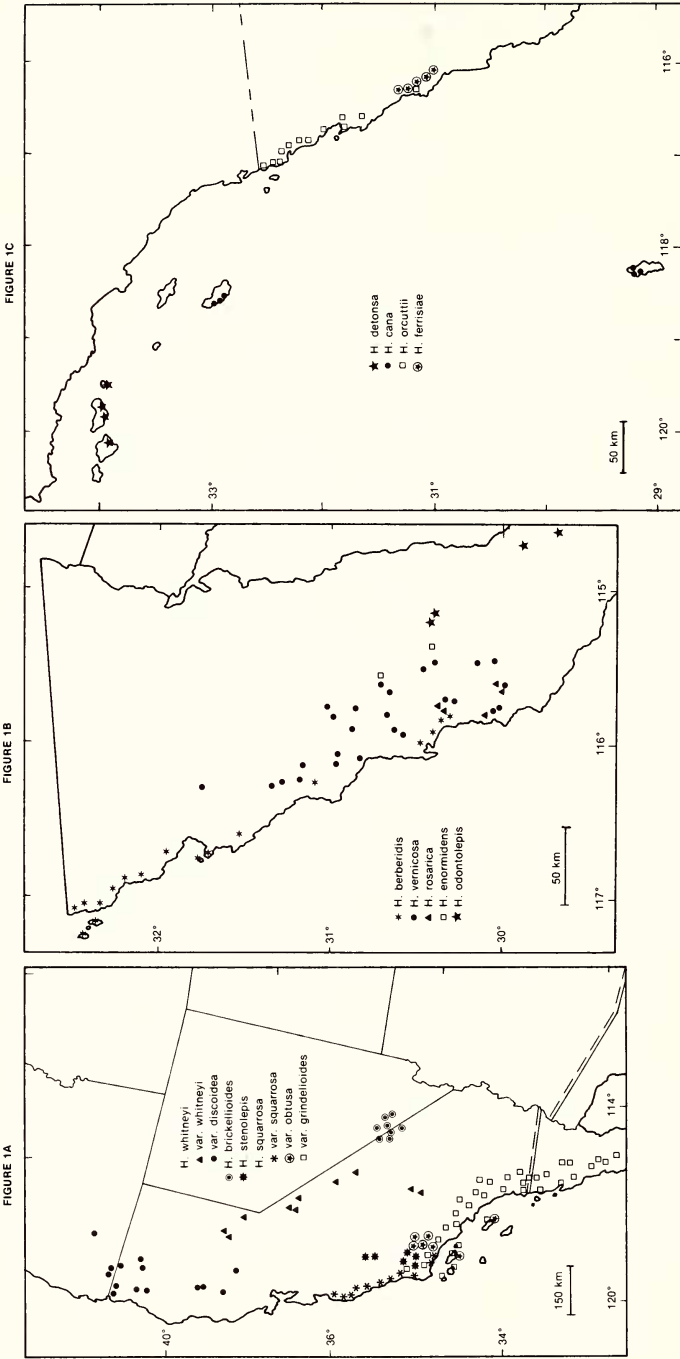


FIG. 1. Distribution of *Hazardia*.

meria and *Asiris* have numbers based on $x = 9$ and are more closely related to *Chrysothamnus* than to *Haplopappus* (Anderson, 1966; Anderson et al., 1974; Urbatsch, 1975, 1978). The affinities of *Hesperodoria* have not been determined, but a chromosome number of $n = 9$ has been reported for its two species (Anderson et al., 1974). *Isopappus*, with $n = 4, 5, 6,$ and 7 has been split into two groups and treated as *Benitoea* (Keck, 1956) and *Croptilon* (Shinners, 1951), though Smith (1965) retained *Croptilon* in *Haplopappus*. *Benitoea* ($n = 5$) and *Croptilon* ($x = 7$) are slender annuals, a habit unknown in *Hazardia*. The former are probably more closely allied to *Chrysopsis*.

Hall (1928) suggested that *Hazardia* is more closely related to *Isocoma* than to any other section of *Haplopappus* in North America. This suggestion seems to be supported by a report of natural hybridization between *Hazardia brickellioides* and *Isocoma acradenia* Greene (Beatley, 1976), but I have examined the specimen of this putative hybrid and it appears to be pure *Isocoma*. Furthermore, an attempted artificial cross between *H. brickellioides* and *I. veneta* Greene was unsuccessful (Jackson, 1968). *Isocoma* seems best treated as a genus (Shinners, 1950; Turner, 1972) and can be distinguished from *Hazardia* by its generally ovate style appendages, abruptly dilated disk corollas, and glomerate capitulescences. It has chromosome numbers based on $x = 6$ and is probably more closely related to other $x = 6$ genera in North America, such as *Grindelia* (Turner, pers. comm.), than to *Hazardia*. However, *H. brickellioides* ($n = 6$) probably represents a distant link to *Isocoma*.

There is some indication of a relationship between *Hazardia* and *Xylorhiza* (*sensu* Watson, 1977). *Hazardia brickellioides* and *Xylorhiza frutescens* (S. Watson) Greene share chromosome number ($n = 6$), habit (small, much-branched, woody shrub), leaf characteristics (spinulose-dentate margins, glandular-scabrid), stem characteristics (glandular-scabrid white bark), and habitat preference (rocky outcrops or hillsides). However, *X. frutescens* has long, heterochromous ligules, monocephalous stems, large heads, and campanulate to hemispherical involucre that are typical of *Xylorhiza*, suggesting a more distant relationship with *Hazardia* through the South American elements of *Haplopappus*. This view is in agreement with Watson's (1977) opinion that *Xylorhiza* is not closely related to any of the North American sections of *Haplopappus* (*sensu* Hall), but may be related to the South American forms.

Hall (1928) considered *Haplopappus* section *Hazardia* and section *Blepharodon* to be distantly related in his phylogenetic scheme. Hartman (1976) has since included most of *Haplopappus* section *Blepharodon* in the genus *Machaeranthera*. Species of this section that have been transferred to *Machaeranthera* have chromosome numbers based on $x = 4$ (Hartman, 1976), while *Hazardia* is predominantly $n = 5$. An exception, *Hazardia whitneyi* ($n = 4$), has a habit, vegetative

morphology, flavonoid chemistry, and geographical distribution that suggest a position near *Machaeranthera grindelioides* (Nutt.) Shinners var. *grindelioides* (formerly *Haplopappus nuttallii* Torr. & Gray). However, these similarities more likely indicate an ancient common origin for *Hazardia* and *Machaeranthera*, because the differences in the floral and fruit morphology between *H. whitneyi* and *M. grindelioides* do not support a close relationship. The remaining *Hazardia* species are woody shrubs or subshrubs, and can thus be distinguished from the mostly herbaceous, taprooted annuals, biennials, and perennials that characterize *Machaeranthera*. Disagreement exists, however, as to the degree of relationship between *Hazardia* and *Machaeranthera* (*sensu* Hartman). Based on chromosome pairing in the F₁ generation of artificial hybrids between *Haplopappus squarrosus* subsp. *squarrosus* (= *Hazardia squarrosa* var. *squarrosa*) and *Haplopappus arenarius* Benth. [= *Machaeranthera arenaria* (Benth.) Shinners], Jackson (1978) suggested a closer relationship and, following Hall (1928), continued to treat them in *Haplopappus* section *Hazardia* and section *Blepharodon*, respectively. However, there must be reservations in judging genomic and phylogenetic relationships strictly on chromosome pairing even in diploid hybrids (Riley and Law, 1965; DeWet and Harlan, 1972), except in networks of interrelated hybrids when the genetic systems of the parent taxa are well understood (Dewey, 1974). As yet, there are not enough cytogenetic data available for a meaningful evaluation within *Haplopappus* (*sensu* Hall). Studies by Jackson (1962, 1966, 1968, 1978) provide excellent examples of the kind of information that is necessary from a wide variety of interspecific and intergeneric hybrids before patterns of cytogenetic relationships can be interpreted taxonomically. At least for now I believe that it is more expedient to maintain *Hazardia* as a distinct genus and to judge its generic relationships on data that are more uniformly available for most or all taxa of concern: morphology, chromosome number, and chemistry (discussed below).

The generic segregation of *Hazardia* is supported for the most part by chemical studies. Except for *H. whitneyi*, which accumulates only flavonol derivatives, *Hazardia* species consistently produce a complex array of glycoflavones and O-glycosides of flavones and flavonols, and usually a number of highly methoxylated flavonol aglycones (Clark and Mabry, 1978). Such a high degree of chemical complexity is known only in *Ericameria* and *Asiris* of Hall's *Haplopappus* (Urbatsch, pers. comm.). Except for *Isocoma*, which appears chromatographically complex but is as yet chemically unknown (Clark, unpub. data), all other former sections of *Haplopappus* that have been examined for flavonoids produce a small number of compounds of usually one and sometimes two classes, i.e., flavones, flavonols, or glycoflavones (Hartman, 1976; Mayes, 1976; Urbatsch, pers. comm.; Clark, unpub. data).

It appears that, as suggested by Hall (1928), the closest relatives of *Hazardia* may be found in *Haplopappus* of South America. Morphologically, *Hazardia berberidis* is very similar to some members of *Haplopappus* section *Polyphylla*, particularly to *Haplopappus deserticolus* Phil. and *H. mucronatus* Hook. & Arn. Additionally, a chromosome number of $n = 5$ has been found for several South American species (Grau, 1976; Jackson, pers. comm.), and $n = 6$ has been counted for one species (Turner et al., 1979). Based on similarity of karyotypes and morphology, Grau (1976) maintains *Hazardia* and South American *Haplopappus* as congeners. In support of this congeneric status, Jackson (pers. comm.) has obtained hybrids between *Hazardia* and *Haplopappus* sections *Haplopappus* and *Polyphylla*. However, as discussed above in relation to chromosome pairing, I do not presently believe that karyotype similarities and mere crossability are useful taxonomic criteria. Future studies may prove otherwise, but the currently available morphological information indicates that South American *Haplopappus* species, except for the almost complete absence of a truly herbaceous habit, are as diverse as their North American counterparts that are treated as separate genera. *Haplopappus* section *Diplostephioides* has been reinstated as the genus *Llerasia* (Cuatrecasas, 1970). Character combinations in section *Haplopappus* suggest affinities with *Xylorhiza* (Watson, 1977) and distinguish it from *Hazardia*: monocephalous stems, long (5–45 cm), mostly leafless peduncles bearing medium-sized to large heads with long-ligulate (>10 mm) ray flowers and appressed phyllaries that form a hemispheric to broad-campanulate involucre. Section *Polyphylla* appears to be equally deserving of generic status separate from section *Haplopappus* and is perhaps congeneric with *Hazardia*. However, it remains for future studies to determine the relationship of *Polyphylla* to *Hazardia*.

Preliminary chemical studies of South American *Haplopappus* reveal a divergence from *Hazardia* (Clark, unpub. data). Species examined from *Haplopappus* sections *Haplopappus*, *Polyphylla*, and *Xylolepis* produce 6-oxygenated flavone glycosides. Compounds of this type are unknown in *Hazardia*; this lends further support to the generic distinctions between North and South American species.

TAXONOMY

HAZARDIA Greene, Pittonia 1:28. 1887.—*Haplopappus* Cass. sect. *Hazardia* (Greene) H.M. Hall, Publ. Carnegie Inst. Wash. 389:36. 1928.—TYPE: *Hazardia cana* (Gray) Greene [= *Diplostephium canum* Gray].

Diplostephium H. B. K. subg. *Aplostephium* Gray, Proc. Amer. Acad. Arts 11:75. 1876.—TYPE: *Hazardia cana* (Gray) Greene [= *Diplostephium canum* Gray].

Plants woody, at least at the base, up to 2.5 m tall. Stems erect,

leafy throughout, much branched, glabrous to densely tomentose, usually resinous. Leaves entire to serrate or dentate, glabrous to densely tomentose, usually resinous, sessile or short-petiolate, usually clasping or subclasping, linear to broadly ovate, obovate, or spatulate, acute to obtuse, to 14 cm long and 5 cm wide. Heads radiate or eradiate, sessile or short-pedunculate. Involucres narrowly or broadly turbinate to campanulate, the bracts imbricate in several series, acute to mucronate or obtuse, frequently glandular-resinous, glabrous to pubescent, entire or few-toothed, frequently squarrose, rigid or herbaceous at apex, linear to oblong or oblanceolate. Ray florets none or 3–25, pistillate, sometimes fertile, yellow or sometimes changing to red-purple, the ligules to 9 mm long and 2 mm wide. Disk florets 4–60, hermaphroditic, fertile or sterile, yellow or sometimes changing to red-purple, usually glabrous, the tube gradually amplified from the middle, 4–10 mm long, the style branches slightly exerted, puberulent throughout or the puberulent appendage shorter than the stigmatic portion. Ray achenes twice as long as or equal to disk achenes; achenes compressed or obcompressed, fusiform to cuneate, 1–10 mm long, 0.5–1.5 mm wide, 4–5-angled, glabrous to densely silky. Pappus of ray and disk similar, composed of about 20–60 scabrous, tawny to reddish-brown capillary bristles, 2.5–12.0 mm long.

Key to *Hazardia*

- Stems mostly herbaceous, arising from a woody root-crown (sect. *Machaerantheroïdes*). 1. *H. whitneyi*.
- Stems woody, arising from a woody trunk.
- Outer involucrel bracts with toothed margins, graduating to leaves; disk florets sterile (sect. *Bracteofolia*).
- Involucres 9–13 mm high; ovaries of (sterile) disk florets equalling those of ray florets.
- Ray florets 6–8, the ligules 5–6.5 mm long; disk florets 11–15, involucres of 25–30 several-nerved bracts. 2. *H. odontolepis*.
- Ray florets 3–6, the ligules 3–4 mm long; disk florets 5–11; involucres of 16–21 one-nerved bracts. 3. *H. enormidens*.
- Involucres 6–7 mm high; ovaries of (sterile) disk florets half as long as those of ray florets. 4. *H. vernicosa*.
- Outer involucrel bracts with entire margins; disk florets fertile (sect. *Hazardia*).
- Heads radiate, the ray florets conspicuous and much longer than the disk.
- Leaf margins serrate. 5. *H. berberidis*.
- Leaf margins entire. 6. *H. orcuttii*.
- Heads eradiate or with ray florets inconspicuous and shorter than the disk.

Heads eradiate.

Leaf margins entire. 7. *H. ferrisiae*.

Leaf margins sharply serrate to dentate.

Pappus bristles 4–6 mm long; florets 5.5–6 mm long.

. 8. *H. rosarica*.

Pappus bristles 7–12 mm long; florets 9–11 mm long.

Florets 4–8; involucre very narrowly turbinate; leaves 15–25 mm long, 7–12 mm wide.

. 9. *H. stenolepis*.

Florets 9–30; involucre turbinate; leaves 15–50 mm long, 10–20 mm wide. 10. *H. squarrosa*.

Heads radiate, the ray florets inconspicuous and shorter than the disk.

Leaves densely tomentose, at least abaxially; shrubs 6–25 dm tall.

Leaves membranous, glabrate adaxially at maturity; bracts with a tuft of loose woolly pubescence at the apex; disk corollas 5–8 mm long. 11. *H. cana*.

Leaves thick, densely tomentose adaxially at maturity; bracts mostly with dense woolly pubescence throughout; disk corollas 8–10 mm long. 12. *H. detonsa*.

Leaves pilose to scabrid; shrubs 2–8 dm tall. 13. *H. brickellioides*.

Hazardia Section **Machaerantheroides** Clark, sect. nov.

A sectionibus *Hazardia* et *Bracteofolia* caulibus herbaceis pro maxima parte, caudicibus lignosis exorientibus, differt.

Stems mostly herbaceous, arising from a woody root-crown.

TYPE SPECIES: *Hazardia whitneyi* (Gray) Greene.

1. HAZARDIA WHITNEYI (Gray) Greene, Pittonia 3:43. 1896. For synonymy and typification see the varietal headings.

Mostly herbaceous perennials 2–5 dm tall. Stems arising from a woody root-crown, few-branched, ascending, tan or purplish to dark brown in age, 0.2–1.5 cm in diameter, 2–5 dm long, herbaceous to woody below, scabrid to sparsely tomentulose above with glandular-stipitate hairs, the internodes averaging 1.5–3.5 cm, striate, leafy throughout. Leaves sessile, clasping, broadly oblong to oblanceolate, acute, 25–50 mm long, 7–16 mm wide, glabrous or sparsely puberulent to glandular-scabrid, the midrib prominent abaxially, the lateral veins inconspicuous and pinnate, the margins serrate, mucronate. Heads radiate or eradiate, solitary, or in spicate, racemose, or cymose capitulescences. Involucre campanulate, shorter than the disk, 11–13 mm high, 8–12 mm wide; bracts 30–40, loosely imbricate in several

series, graduating to leaves, the apex herbaceous and moderately stipitate-glandular, resinous, chartaceous at the base, linear-lanceolate, acute, often becoming purplish, the margins membranous, 5–12 mm long, 1–1.5 mm wide, occasionally squarrose. Disk florets 15–30, yellow, the anthers 3.5–4 mm long, the style branches 2–3 mm long, lanceolate, acute, the puberulent appendage equal to or slightly longer than the stigmatic portion. Achenes 5–10 mm long, 1–1.5 mm wide, narrowly ovate, glabrous, 5-angled and striate between the angles. Pappus of 40–60 scabrous, brownish bristles, 7–10 mm long. Chromosome number, $n = 4$ (Anderson et al., 1974).

Heads radiate; disk achenes mostly 5–7 mm long; Sierra Nevada, CA. 1a. var. *whitneyi*.
Heads eradiate; achenes to 10 mm long; mts of NW CA and adjacent OR. 1b. var. *discoidea*.

- 1a. **HAZARDIA WHITNEYI** (Gray) Greene var. **WHITNEYI**.—*Haplopappus whitneyi* Gray, Proc. Amer. Acad. Arts 7:353. 1868.—*Aster whitneyi* (Gray) Kuntze, Rev. Gen. Pl. 1:318. 1891.—TYPE: USA: CA: Mono Co.: Mono Trail and Sonora Pass, 2800 m, 1866, *Bolander 6008* (Holotype: GH!; Isotypes: F!, MO!, NY!, UC!, US!)

Ray florets 5–18, yellow, the ligules 5–8 mm long, 1–2 mm wide, oblanceolate, the corolla tubes 4–5 mm long, styles inconspicuous, achenes undeveloped. Disk achenes to 8 mm long.

Distribution. Uncommon in occasional localities throughout the Sierra Nevada from Plumas Co. to Kern Co., CA (Fig. 1A); usually associated with species of *Abies*, *Pinus*, *Tsuga*, *Ceanothus*, and *Arctostaphylos* at 1200–3500 m; flowering Jul–Sep.

- 1b. **Hazardia whitneyi** (Gray) Greene var. **discoidea** (J. T. Howell) Clark, comb. nov.—*Haplopappus whitneyi* var. *discoideus* J. T. Howell, Leafl. W. Bot. 6:84. 1950.—*Haplopappus whitneyi* ssp. *discoideus* (J. T. Howell) Keck, Aliso 4:103. 1958.—TYPE: USA: CA: Siskiyou Co.: Shackleford Creek Trail S of Sky High Valley, Marble Mountains, 9 Aug 1939, J. T. Howell 15236 (Holotype: CAS!; Isotypes: DS!, GH!, US!)

Distribution. Uncommon in occasional localities of the inner North Coast Ranges from Lake Co. to Siskiyou and Del Norte cos., CA and adjacent OR (Fig. 1A); usually associated with species of *Abies*, *Pinus*, *Tsuga*, *Ceanothus*, and *Arctostaphylos* at 1000–2500 m; flowering Jul–Sep.

Placement of *Hazardia whitneyi* within the genus is problematical. B. L. Turner (pers. comm.) noted its superficial similarity to *Ma-*

chaerantha grindelioides (Nutt.) Shinners. *Hazardia whitneyi* has a chromosome number ($n = 4$), habit (perennial herb, the new shoots arising from a tough woody rootstock), geographical distribution, and flavonoid chemistry (flavonol derivatives only) that suggest a position with or near *M. grindelioides*. However, comparison of floral and fruit characters of these two taxa does not suggest a close relationship. *Hazardia whitneyi* is therefore treated as a monotypic section of *Hazardia*, named for its superficial resemblance to *M. grindelioides*. Future workers might consider yet other positions among the various generic segregates of *Haplopappus*, but it seems best to me to consider the taxon as an ancient aneuploid derivative from an element, in the phyletic sense, of both *Machaerantha* and *Hazardia*.

Hazardia Section **Bracteofolia** Clark, sect. nov.

A sectionibus *Hazardia* et *Machaeranthroides* floribus discibus sterilibus et bracteis cum marginibus dentatis differt.

Woody shrubs; involucre bracts with toothed margins, graduating to leaves; disk florets sterile.

TYPE SPECIES: *Hazardia vernicosa* (Brandege) Clark.

The distinctness of the species here included in section *Bracteofolia* was pointed out by Moran (1976), who also noted the relationships within this group and between it and the present section *Hazardia*. Section *Bracteofolia* is so named to emphasize its toothed, leaflike outer bracts, which are unique within the genus.

2. **Hazardia odontolepis** (Moran) Clark, comb. nov.—*Haplopappus odontolepis* Moran, Trans. San Diego Soc. Nat. Hist. 15:157. 1969.—TYPE: Mexico: Baja California: Rare on the N slope at 1400 m, near the summit of Cerro Potrero (near 29°49'N, 114°37'W), 30 May 1965, *Moran 12162* (Holotype: SD!; Isotypes: CAS!, GH!, ICF, K!, KANU!, NY!, UC!, US!)

Glutinous shrublet 1–3 dm tall, with branches ascending from a woody stock 5–10 cm tall and to 2.5 cm in diameter. Young branches simple or few branched above, light tan, 1 mm in diameter, 1–2 dm long, sparsely hispidulous, leafy throughout, with internodes averaging 2–6 mm, angled from leaf margins and midrib downward, smaller leaves often fascicled in axils of larger ones; older stems dark gray, shredding, to 6 mm in diameter. Leaves sessile and subclasping, elliptic to cuneate-oblongate, acute, 5–20 mm long, 4 mm wide, coriaceous, glandular-pitted and slightly to heavily resinous, moderately hispidulous either mostly near margins and veins or throughout, the midrib prominent abaxially, the lateral veins less prominent to obscure, the apex deflexed, tipped with a white spine to 0.5 mm long,

the margins with 4–6 spinose teeth, 0.5–1 mm long, irregularly spaced. Heads radiate, solitary at ends of branchlets or in cymose capitulescences with 2–4 heads on peduncles 1–12 mm long, from upper axils except when solitary. Involucre cylindrical or subfusiform, shorter than disk, 9–13 mm high, 3–5 mm wide exclusive of squarrose tips; bracts 25–30, outer ones spiny-margined, graduating into leaves, inner ones subequal, oblong to linear, several-nerved, acute, yellowish, 8–10 mm long, 1–2 mm wide, with margins erose-ciliate. Ray florets 6–8, fertile, yellow, the ligules 5–6.5 mm long, 1.5–2 mm wide, irregularly 3-lobed, the corolla-tubes 5–5.5 mm long, the style branches linear, obtuse, 1–1.5 mm long, stigmatic to apex. Achenes obcompressed, cuneate, 3–4 mm long, 1 mm wide, sparsely ascending-strigose, with 5 white nerves. Disk florets 11–15, sterile, yellow, the corolla 7–9 mm long, the anthers 2.5–3 mm long, the style branches 1.5–2 mm long, linear, the puberulent appendage 1–2 times longer than the stigmatic part. Ovaries of the disk florets equalling those of the ray florets. Pappus of 40–50 scabrous, brownish bristles, 4–5.5 mm long.

Distribution. Locally common on bare, rocky slopes, on peaks S of the Sierra San Pedro Mártir, Baja California, Mex. (Fig. 1B); usually associated with species of *Juniperus*, *Quercus*, *Yucca*, and *Prunus* at 1150–1450 m; flowering May–Jun.

This taxon most closely resembles *H. enormidens* and *H. vernicosa*, differing primarily in the number and size of involucre. Of these three species, *H. odontolepis* is most like other members of *Hazardia* in its larger, subclasping leaves, in its larger heads with more numerous florets, and in the presence of stigmatic lines along the style branches of its disk florets.

3. ***Hazardia enormidens*** (Moran) Clark, comb. nov.—*Haplopappus enormidens* Moran, *Phytologia* 34:371. 1976.—TYPE: Mexico: Baja California: Ridge 5 km SW of San Isidoro (7.5 km by road), ca. 1170 m, SW foothills of the Sierra San Pedro Mártir (near 30°44'N, 115°34'W), 19 Jul 1975, *Moran and Reveal* 22062 (Holotype: SD!; Isotypes: ASU!, SD!, to be distributed)

Glutinous shrublet 1–3 dm tall, much branched from a woody crown. Branchlets flexuous, light green, soon becoming tan, gray in age, 0.5–1 mm in diameter, 1.5 dm long, sparsely hispidulous, leafy throughout, with internodes averaging 3–6 mm, angled from leaf margins and midrib downward, mostly with small few-leaved fascicles in axils. Leaves sessile and subclasping-decurrent, elliptic to oblong, acute, 6–10 mm long, 2 mm wide at base to 3 mm wide above, coriaceous, glandular-pitted to heavily resinous, moderately hispidulous either mostly near margins or throughout, the midrib prominent abaxially, the lateral veins less prominent to obscure, the apex deflexed, tipped with a white spine to 0.5 mm long, the margins entire or with

1–9 spinose teeth 0.2–0.5 mm long, very irregularly spaced. Heads radiate, solitary at ends of branchlets or in cymose capitulescences with 2–4 heads on peduncles 1–12 mm long, from upper axils except when solitary. Involucres cylindrical or subfusiform, shorter than disk, 9–12 mm high, 2–3 mm wide exclusive of squarrose tips; bracts 15–20, outer ones spiny-margined and graduating into leaves, inner ones subequal, linear, 1-nerved, acute, green to yellowish, 6–9 mm long, 1–2 mm wide, with margins erose-ciliate above. Ray florets 3–6, fertile, yellow, the ligules 3–4 mm long, 1–1.3 mm wide, scarcely toothed at apex, the corolla tubes 3–5 mm long, the style branches linear, obtuse, 0.6–1.4 mm long, stigmatic to apex. Achenes obcompressed, cuneate, 3–4 mm long, 1 mm wide, sparsely ascending-strigose, with 5 white nerves. Disk florets 5–11, sterile, yellow, the corolla slightly ampliate from the middle, 7–9 mm long, the anthers 2.5–3 mm long, the style branches 1–2 mm long, linear, puberulent throughout, lacking evident stigmatic lines. Ovaries of the disk florets equalling those of the ray florets. Pappus of 45–55 scabrous, brownish bristles, 4–6 mm long. Chromosome number, $n = 5$ (Moran, 1976).

Distribution. Locally abundant in open areas at the edge of chaparral, known only from the type locality and from about 40 km SSE, S of Rancho San Miguel, Baja California, Mex. (Fig. 1B); usually associated with species of *Juniperus*, *Adenostoma*, *Yucca*, and *Agave* at 975–1175 m; flowering Jul–Aug.

Hazardia enormidens is like *H. odontolepis* in leaf shape and relative size of disk ovaries and like *H. vernicosa* in having one-nerved bracts and in lacking stigmatic lines along the style branches of the disk florets. *Hazardia enormidens* has been suggested to form natural hybrids with *H. vernicosa* [Moran, 1976; cf. *Moran and Reveal 22607a & b* (ASU, SD)].

4. ***Hazardia vernicosa*** (Brandege) Clark, comb. nov.—*Haplopappus vernicosus* Brandege, Proc. Calif. Acad. Sci. II, 2:168. 1889.—non Reiche, Fl. Chil. 3:312. 1902.—TYPE: Mexico: Baja California: El Rosario, 20 May 1889, *Brandege s.n.* (Holotype: UC!; Isotypes: GH!, NY!, US!)

Glutinous shrublet 2–3 dm tall, much branched from a woody crown. Branchlets light green to brown, gray with age, 0.5–1 mm in diameter, 1–2 dm long, glabrous, resinous and granular, leafy throughout, with internodes averaging 3–6 mm, angled from leaf margins and midrib downward, mostly with small, few-leaved fascicles in axils. Leaves with narrowed, petiole-like base, cuneate-obovate to cuneate-oblongeolate, acute, 6–9 mm long, 1 mm wide at base to 5 mm wide above, coriaceous, glandular-pitted, heavily resinous, sparsely hispidulous on midrib or glabrous, midrib prominent abaxially, the lateral veins obscure, the apex deflexed, tipped with a white

spine less than 0.5 mm long, the margins with 4–6 spinose teeth to 0.5–1 mm long, irregularly spaced. Heads radiate, solitary at ends of branchlets or in cymose capitulescences with 2–3 heads on peduncles 1–10 mm long, from upper axils except when solitary. Involucres cylindrical-turbinate, shorter than disk, 6–7 mm high, 2–3 mm wide exclusive of squarrose tips; bracts 15–20, outer ones spiny-margined and graduating into leaves, inner ones subequal, oblong to linear, 1-nerved, acute, green to yellowish with green tips, 4–6 mm long, to 1 mm wide, with margins mostly ciliate. Ray florets 3–5, fertile, yellow, the ligules to 3 mm long, to 1 mm wide, obtuse, the corolla tubes 2–4 mm long, the style branches linear, obtuse, 0.5–1.4 mm long, stigmatic to apex. Achenes to 2 mm long, to 0.5 mm wide, obcompressed, angled, truncate, densely silky. Disk florets 4–8, sterile, yellow, the corolla slightly ampliate from the middle, 4–5 mm long, the teeth 0.6 mm long, the anthers 2.5–3 mm long, the style branches 1–2 mm long, linear, acute, puberulent throughout, lacking evident stigmatic lines. Ovaries of the disk florets half as long as those of the ray florets. Pappus of 30–40 white to brownish, scabrous bristles, 3–4 mm long. Chromosome number, $n = 5$ (Keil and Pinkava, 1976).

Distribution. Usually abundant in many localities in the foothills from N of San Vicente to SE of El Rosario, Baja California, Mex. (Fig. 1B); sometimes associated with species of *Juniperus*, *Yucca*, *Agave*, and *Quercus* at 50–1200 m; flowering Jun–Jul.

Hazardia vernicosa is most closely related to *H. odontolepis* and *H. enormidens*. Of these three species, *H. vernicosa* is the most divergent from the other members of *Hazardia*. Its unique characters are smaller leaves with petiole-like bases, smaller heads with fewer and smaller florets, and ovaries of the disk florets half as long as those of the ray florets rather than of equal size. *Hazardia vernicosa*, like *H. enormidens*, has one-nerved bracts and lacks stigmatic lines along the style branches of the disk florets.

HAZARDIA Section HAZARDIA

Woody shrubs; outer involucral bracts with entire margins; disk florets fertile.

5. HAZARDIA BERBERIDIS (Gray) Greene, *Erythea* 2:112. 1894.—*Haplopappus berberidis* Gray, *Syn. Fl.* 1²:126. 1884.—*Aster berberidis* (Gray) Kuntze, *Rev. Gen. Pl.* 1:317. 1891.—TYPE: Mexico: Baja California: All Saint's Bay, Jul 1882, *F. E. Fish s.n.* (Holotype: GH!; Photographs: NY!, UC!; Isotypes: K!, US!)
- Haplopappus cruentus* Greene, *Pittonia* 2:17. 1889.—*Hazardia cruenta* (Greene) Greene, *Erythea* 2:112. 1894.—TYPE: Mexico: Baja California: On the largest of the Coronado Islands, 4 Jun 1889, *C. F. Pond s.n.* (Holotype: ND-G; Isotype: ND-G)

Woody shrub 0.5–2 m tall, loosely branched. Branches brown to gray in age, 3–30 mm in diameter, 5–10 dm long, sparsely villous, leafy throughout, with internodes averaging 1–2.5 cm, striate, often with small few-leaved fascicles in axils. Leaves sessile, clasping, oblong to obovate or subspatulate, obtuse, 20–50 mm long, 3–10 mm wide below to 18 mm wide above, coriaceous, glabrous to sparsely hispidulous toward base of midrib, the midrib prominent abaxially, the lateral veins pinnate and impressed, the margins acutely to spinosely serrate throughout. Heads radiate, solitary at ends of branches or in racemose capitulescences, sessile, or on leafy peduncles to 3 cm long. Involucres broadly turbinate to campanulate, shorter than the disk, 1–2 cm high, 1–1.5 cm wide; bracts 30–60, imbricated in several series, rigidly chartaceous, glutinous, with darkened green apex 1–3 mm long and resinous-granular, oblong-obtuse to broadly acute, 3–10 mm long, 1–2 mm wide, with margins erose-ciliate. Ray florets 15–25, yellow or aging to dark red-purple, the ligules 6–9 mm long, 1.5–2 mm wide, minutely 3-lobed at the apex, oblanceolate, the corolla tubes 4–5 mm long, the style branches 1–1.5 mm long, linear, obtuse, 0.6–1.4 mm long, stigmatic to apex. Disk florets 30–60, yellow or aging to dark red-purple, the anthers 3–5 mm long, the style branches 1.5–2.5 mm long, linear, broadly acute, the puberulent appendage shorter than or equalling the stigmatic portion. Ray and disk achenes similar, compressed, 5–6 mm long, 0.5–1 mm wide, glabrous, 4-angled and striate between the angles. Pappus of 30–50 scabrous, brownish bristles, 6–9 mm long. Chromosome number, $n = 5$ (fide R. C. Jackson on labels of *Moran 13435, 21055*).

Distribution. Locally abundant from beaches to foothills from El Socorro N to Rosarito, Baja California, Mex., and on adjacent Coronados and Todos Santos Islands (Fig. 1B); usually associated with species of *Agave*, *Artemisia*, *Simmondsia*, *Opuntia*, *Rhus*, and *Atriplex* at 5–380 m; flowering Mar–Sep.

Hazardia berberidis is similar in habit and leaf morphology to the radiate *H. squarrosa* and *H. rosarica*. It forms natural hybrids with the entire-leaved *H. orcuttii* (Hall, 1928; cf. *Clark 1099, 1101a–d, 1102a–d* (ASU, LL), *Hall 12253* (UC), *Moran 13441* (ARIZ, DS, MICH, RSA, SD), *Moran 14516, 14637* (SD), *Rose 60078, 60079* (CAS, NY, RSA)) and *H. ferrisiae* (cf. *Moran 14070* (DS, MICH, NY, RSA, SD, US)). *Hazardia berberidis* has many features in common with *Haplopappus* section *Polyphylla* of Chile, supporting previous suggestions that *Hazardia* and *Haplopappus* had a common origin (Hall, 1928; Turner, pers. comm.). Their present disjunction, between Baja California and Chile, suggests that one gave rise to the other, but the direction of evolution is not yet known.

6. HAZARDIA ORCUTTII (Gray) Greene, *Erythea* 2:112. 1894.—*Haplopappus orcuttii* Gray, *Proc. Amer. Acad. Arts* 20:297. 1885.—

TYPE: Mexico: Baja California: All Saint's Bay, 22 Sep 1884, C. R. Orcutt 1230 (Holotype: GH!; Isotypes: A!, F!, MICH!, NY!, UC!, US!; fragments, UC!)

Resinous shrub 5–10 dm tall. Woody branches few and open to 30 mm in diameter below, 3–5 mm above, 3–8 dm long, glabrous and slightly resinous, leafy throughout, with internodes averaging 2–8 mm, minutely ribbed or angled from leaf midrib downward, occasionally with few and small-leaved fascicles in axils of much larger leaves. Leaves sessile and subclasping, spatulate-lanceolate to narrowly obovate, acute to occasionally obtuse below, mucronate, 20–50 mm long, 3–15 mm wide, coriaceous, resinous-punctate, glabrous, the midrib prominent, the lateral veins reticulate and inconspicuous, the margins entire or rarely few-toothed below. Heads radiate, in racemose or paniculate capitulescences from 5–15 cm in length, up to 50 cm, the peduncles reduced or absent above to 2 mm long below. Involucres turbinate, shorter than disk, 7–10 mm high, 4–6 mm wide exclusive of the squarrose tips; the bracts 30–40 in several series, linear, acute to obtuse, light green, with a resinous glandular-dotted apex, 4–6 mm long, to 1 mm wide, the margins scarious. Ray florets 8–12, fertile, yellow, the ligules 2–3 mm long, to 1.5 mm wide, broadly acute, the corolla tubes 3–4 mm long, the style branches linear, obtuse, 1–1.5 mm long, stigmatic to apex. Disk florets 10–20, fertile, yellow, glabrous, the corolla slightly ampliate from the middle, 5–7 mm long, the lobes broadly acute, to 0.8 mm long, the anthers 2–2.5 mm long, the style branches 1.5–2 mm long, sublanceolate, obtuse, the puberulent appendage nearly equalling the stigmatic portion. Ray and disk achenes similar, or those of rays slightly shorter, subcylindric but tapering slightly to the base, faintly ribbed, 3–4.5 mm long, to 1 mm wide, sparsely ascending-strigose. Pappus of 20–30 scabrous, brownish bristles, 4–5 mm long. Chromosome number, $n = 5$ (fide R. C. Jackson on label of *Moran 13440*).

Distribution. Locally common in open habitats, coastal plains and hills from Colonet to Tijuana, Baja California, Mex. (Fig. 1C); usually associated with species of *Agave*, *Artemisia*, *Simmondsia*, *Opuntia*, and *Rhus* at 10–200 m; flowering Aug–Sep.

Hazardia orcuttii probably hybridizes in nature with *H. ferrisiae* (cf. Clark *et al.* 1097b-l (ASU, LL); *Moran 14067* (DS, RSA, SD, US)).

7. ***Hazardia ferrisiae*** (Blake) Clark, comb. nov.—*Haplopappus ferrisiae* Blake, Proc. Biol. Soc. Wash. 48:171. 1935.—TYPE: Mexico: Baja California: Playa S of San Vicente, 13 Aug 1933, W. S. Cooper 75 (Holotype: DS!; photograph and fragments, US!)

Glutinous shrublet 2–5 dm tall, much branched from a woody base. Branches brownish, 1–2 mm in diameter, 1–3 dm long, glabrous and

resinous, leafy throughout, with internodes averaging 1–5 mm, angled from leaf margins and midrib downward, occasionally with small few-leaved fascicles in axils. Leaves sessile, oblanceolate to linear, acute, 10–15 mm long, 2–3 mm wide, coriaceous, glandular pitted to heavily resinous, glabrous, the midrib prominent to obscure, the lateral veins reticulate and impressed, the margins entire. Heads eradiate, or in cymose capitulescences with 3–15 subsessile heads crowded at ends of branches. Involucres narrowly turbinate, nearly equalling the disk, 5–7 mm high, 2–3 mm wide; bracts 10–15, the outer ones to 2 mm long and 0.8 mm wide, the inner ones to 8 mm long and 0.8 mm wide, with margins scarios and sparsely ciliate above, subulate to linear, acute, with a brown carinate glandular apex. Florets 7–12, yellow, the corolla slightly ampliate from the middle, 5–7 mm long, the teeth 0.6–0.8 mm long, the anthers 2.5–3 mm long, the style branches 0.9–1.5 mm long, the puberulent appendages equalling the stigmatic portion. Achenes obovate, 1.5–2 mm long, to 0.5 mm wide, ascending-strigulose, 5-nerved. Pappus of 30–40 scabrous, brownish bristles, 2.5–4 mm long. Chromosome number, $n = 5$ (fide R. C. Jackson on label of *Moran 1400*).

Distribution. Common on coastal plains and mesas in the region of Colonet, Baja California, Mex. (Fig. 1C); associated with species of *Agave*, *Opuntia*, *Rosa*, *Ambrosia*, and *Mesembryanthemum* at 25–150 m; flowering Jun–Aug.

8. **Hazardia rosarica** (Moran) Clark, comb. nov.—*Haplopappus rosaricus* Moran, Trans. San Diego Soc. Nat. Hist. 15:159. 1969.—
 TYPE: Mexico: Baja California: Locally common on N slope at 75 m, Arroyo del Campo Viejo, 2.3 miles SE of El Consuelo and 7.2 miles NNW of El Rosario (near 30°09'N, 115°46'W), 2 Jul 1967, *Moran 14020* (Holotype: SD!; Isotypes: ARIZ!, CAS!, GH!, KANU!, MICH!, MO!, NY!, RSA!, UC!, UCLA!, US!)

Glutinous shrub 2–9 dm tall, much branched from a woody base. Branchlets zigzag, slender, to 1 mm in diameter, 1–4 dm long, brown turning to gray in age, lower woody portions to 3 mm in diameter, glutinous to granular, leafy throughout, with internodes averaging 5–15 mm, angled from leaf margins and midrib downward, occasionally with small few-leaved fascicles in axils. Leaves sessile and subclasping to subpetiolate, obovate to spatulate, obtuse to rounded-acute, 10–25 mm long, 1–2 mm wide at base to 5–12 mm wide above, coriaceous, glandular-pitted to heavily resinous, glabrous, the midrib obscure or slightly protruding abaxially in lower portion, the lateral veins obscure, the margins dentate with 2–8 white, spinose-tipped, deltoid teeth, 0.5–1.5 mm long, regularly to irregularly spaced. Heads eradiate, solitary at ends of branchlets, or in thyrsoid capitulescences with 1–3 sessile or subsessile in upper axils. Involucres turbinate,

shorter than disk, 8–12 mm high, 3.5–5 mm wide; bracts 30–60, imbricated in 5–8 series, erect or with tips slightly spreading, chartaceous with scarious margins and short herbaceous tips, abaxially and adaxially glandular near apex, erose and spinose-mucronate, to 1 mm wide, 2–7 mm long, oblong to linear-oblongate. Florets 15–25, yellow, corolla gradually ampliate from the middle, 5.5–6.5 mm long, the lobes erect, acute, 0.6–0.9 mm long, the anthers 1.5–2 mm long, the style branches 1–1.5 mm long, the appendage ovate, acute, puberulent, nearly equalling the stigmatic portion. Achenes subterete, narrowing at both ends but less so at apex, 3–3.5 mm long, 1–1.5 mm wide, dark to black, with 5 white nerves, sparsely appressed-pubescent. Pappus of 25–40 scabrous, white to brownish bristles, 4–6 mm long. Chromosome number, $n = 5$ (Moran, 1969; Keil and Pinkava, 1976).

Distribution. Locally abundant on N and E slopes and ridges, within 8 km of the sea, from NE of El Socorro to SE of El Rosario, Baja California, Mex. (Fig. 1B); usually associated with species of *Agave*, *Ambrosia*, *Aesculus*, *Dudleya*, and *Berberocactus* at 75–475 m; flowering Jun–Oct.

9. *HAZARDIA STENOLEPIS* (Hall) Hoover, Vasc. Pl. San Luis Obispo Co. Calif. 296. 1970.—*Haplopappus squarrosus* ssp. *stenolepis* Hall, Publ. Carnegie Inst. Wash. 389:253. 1928.—TYPE: USA: CA: Fresno Co.: Parkfield Grade, 12 km from Coalinga, 13 Oct 1921, Hall 11767 (Holotype: UC!; Isotypes: DS!, GH!)

Dense shrub 3–10 dm tall, very woody at the base. Branches whitish to brown or gray in age, 0.2–1.5 cm in diameter, 1–6 dm long, coarsely to finely scabrous, with internodes averaging 0.3–1.5 cm, striate, often with small few-leaved fascicles in axils. Leaves sessile, subclasping, oblong to obovate, obtuse, mucronate, 15–25 mm long, 7–12 mm wide, coriaceous, glabrous, resinous, the midrib prominent abaxially, the lateral veins obscure, the margins sharply serrate to dentate with mucronate teeth. Heads eradiate, in densely spicate capitulescences 3–15 cm long. Involucres very narrowly turbinate, shorter than the disk, 10–17 mm high, 3–6 mm wide; bracts 20–30, loosely imbricated in several series, chartaceous, glabrous, slightly glutinous at the apex, erect or slightly spreading, linear, acute, 3–23 mm long, to 1 mm wide. Florets 4–8, yellow, the corolla gradually ampliate from the middle, 9–11 mm long, the lobes erect, 0.7–1 mm long, the anthers 3.5–4 mm long, the style branches 2–2.5 mm long, linear, acute, the puberulent appendage equal to or slightly exceeding the stigmatic portion. Achenes compressed, 5–8 mm long, 0.5–1 mm wide, glabrous, 5-angled and striate between the angles. Pappus of 40–60 scabrous, red-brown bristles, 7–12 mm long. Chromosome number, $n = 5$ (Anderson et al., 1974).

Distribution. Locally common on serpentine or loose shale, dry soils of the Inner Coast Ranges, E Monterey, San Luis Obispo, and Santa Barbara cos. and W Fresno Co., CA (Fig. 1A); usually associated with species of *Quercus*, *Pinus*, *Ceanothus*, *Arctostaphylos*, *Heteromeles*, and *Artemisia* at 150–1200 m; flowering Sep–Nov.

10. HAZARDIA SQUARROSA (Hook. & Arnott) Greene, *Erythea* 2:112. 1894.—For synonymy and typifications see the varietal headings.

Multi-stemmed shrub 3–23 dm tall with a hard woody base to 4 cm in diameter. Branches tan to gray in age, 0.2–3 cm in diameter, 2–8 dm long, glabrate to tomentulose above, with internodes averaging 1–2.5 cm, striate, often with small few-leaved fascicles in axils. Leaves sessile, clasping, oblong to obovate or subspatulate, obtuse, 15–50 mm long, 10–20 mm wide, coriaceous to rigidly chartaceous, glabrous or puberulent on upper surface, sometimes resinous, the midrib prominent abaxially, the lateral veins obscure, the margins sharply serrate to dentate, sometimes mucronate. Heads eradiate, in racemose-spicate or glomerate-spicate capitulescences 4–20 cm long. Involucres turbinate, shorter than the disk, 8–15 mm high, 7–10 mm wide exclusive of the squarrose bracts; bracts 30–60, closely imbricated in several series, chartaceous at base, the apex glandular-pubescent or glabrous and resinous, erect, oblong to lanceolate, acute to obtuse, sometimes mucronate, 3–10 mm long, 1–2 mm wide. Florets 9–30, yellow or reddish, the corolla gradually ampliate from the middle, 9–11 mm long, the lobes erect or slightly spreading, 0.7–1.2 mm long, the anthers 3.5–4 mm long, the style branches 2.5–3 mm long, linear, acute, the puberulent appendage shorter than or nearly equal to the stigmatic portion. Achenes obovate, 5–8 mm long, 0.5–1.2 mm wide, glabrous, 5-angled and striate between the angles. Pappus of 40–60 scabrous, white to red-brown or tawny bristles, 7–12 mm long. Chromosome number, $n = 5$ (DeJong and Montgomery, 1963; Jackson, 1968, 1978; fide Jackson on labels of *Moran 13548*, *13575*, *13611*; fide Pinkava on label of *Clark 1105*).

Stems glabrate to sparsely pubescent above or scabrid and resinous; leaves glabrous, resinous; involucres 11–15 mm high; florets 18–30, the corollas 10–11 mm long; pappus tawny.

Stems glabrate to sparsely pubescent above; bracts glandular-pubescent, obtuse to acute, squarrose. . . . 10a. var. *squarrosa*.

Stems glabrous to scabrid, resinous; bracts smooth resinous, obtuse to subtruncate, mucronate, erect or slightly spreading, never squarrose. 10b. var. *obtusula*.

Stems often tomentulose, especially near heads, not resinous; leaves often sparsely pubescent on upper surface, rarely resinous; involucres 8–12 mm high; florets 9–16, the corollas 9–10 mm long; pappus white to red-brown. 10c. var. *grindelioides*.

- 10a. *HAZARDIA SQUARROSA* var. *SQUARROSA*—*Haplopappus squarrosus* Hook. & Arnott, Bot. Beech. Voy. 146. 1833.—TYPE: USA: CA: Monterey Co.: Locality not definitely stated but probably in the vicinity of Monterey, exact date not stated, *Beechey Voyage s.n.* (Holotype: K!; photograph and fragments: UC!; photograph: US!)

Distribution. Locally abundant in foothills and coastal mountains, from Monterey to Santa Barbara and E in the mountains surrounding the Salinas Valley, CA (Fig. 1A); usually associated with species of *Quercus*, *Artemisia*, *Arctostaphylos*, *Ceanothus*, *Heteromeles*, and *Pinus* at elevations of 20–700 m; flowering Aug–Oct.

- 10b. *HAZARDIA SQUARROSA* var. *OBTUSA* (Greene) Jepson, Man. fl. pl. Calif. 1030. 1925.—*Hazardia obtusa* Greene, Fl. Franciscana 375. 1897.—*Haplopappus squarrosus* ssp. *obtusus* (Greene) Hall, Publ. Carnegie Inst. Wash. 389:253. 1928.—*Haplopappus squarrosus* var. *obtusus* (Greene) McMinn, Illus. man. Calif. shrubs 571. 1951.—TYPE: USA: CA: Kern Co.: San Emigdio Canyon, 2 Oct 1894, *Eastwood s.n.* (Holotype: ND-G; photograph and fragments: UC!; Isotypes: GH!, UC!)

Distribution. Locally common in dry canyons of mountains in W Kern Co. and adjacent Ventura Co., CA (Fig. 1B); usually associated with species of *Quercus*, *Eriogonum*, *Pinus*, *Arctostaphylos*, and *Ceanothus* at 600–1200 m; flowering Sep–Nov.

- 10c. *Hazardia squarrosa* var. *grindelioides* (DC.) Clark, comb. nov.—*Pyrrcoma grindelioides* DC., Prodr. 5:350. 1836.—*Aster grindelioides* (DC.) Kuntze, Rev. Gen. Pl. 1:316. 1891.—*Haplopappus squarrosus* ssp. *grindelioides* (DC.) Keck, Aliso 4:103. 1958.—TYPE: USA: CA: Exact locality and date not stated [probably in the vicinity of Santa Barbara, based on Douglas' itinerary; "1833" on label probably refers to date specimen was received in England since Douglas' California collecting was almost entirely during 1831–1832 (Jepson, Madroño 2:97. 1933)], *Douglas 60* (Holotype: G-DC; photograph and fragments: UC!)

Distribution. Locally common in foothills and coastal mountains and islands from Santa Barbara Co., CA, S into the interior of N Baja California, Mex. (Fig. 1A); usually associated with species of *Quercus*, *Pinus*, *Arctostaphylos*, *Rhus*, *Heteromeles*, *Adenostoma*, and *Ceanothus* at 100–1300 m; flowering Jul–Oct.

Hazardia squarrosa is the most variable species of *Hazardia*, diverging morphologically to form three varieties over a wide distributional range. Intermediates are found between var. *squarrosa* and var. *grindelioides* in some areas of Santa Barbara County, and interme-

diates between var. *grindelioides* and var. *obtusata* occur in a few locations in Ventura County. Raven (1963) reported that natural hybrids are formed between *H. squarrosa* var. *grindelioides* and *H. detonsa* on Santa Cruz Island, resulting in plants like that named *H. serrata* (see Excluded Names; cf. *Clark 1035, 1062* (ASU, LL), *Pollard s.n.* (CAS), *Raven and Smith 15285* (JEPS), *Wilken 8807* (UCSB)).

11. HAZARDIA CANA (Gray) Greene, Pittonia 1:29. 1887.—*Diplostegium canum* Gray, Proc. Amer. Acad. Arts 11:75. 1876.—*Corsethygyne cana* (Gray) Greene, Bull. Calif. Acad. Sci. 1:223. 1886.—*Haplopappus canus* (Gray) Blake, Contr. U. S. Natl. Herb. 24:86. 1922.—TYPE: Mexico: Baja California: Guadalupe Island, 28 Mar 1875, *Palmer 39* (Holotype: GH!; Isotypes: F!, GH!, MO!, NY!)

Haplopappus traskae Eastwood, Proc. Calif. Acad. Sci. ser. 4, 20:156. 1931.—TYPE: USA: CA: San Diego Co.: San Clemente Island, Jun 1903, *Trask 292* (Holotype: CAS; Isotypes: NY!, US!)

Open rounded shrub 6–20 dm tall, loosely branched. Branches irregular, 1–5 mm in diameter, 1–10 dm long, moderate to densely lanate-tomentose, lower woody portions to 3 cm in diameter with tomentum irregularly distributed and revealing light brown bark, leafy to capitulescence, with internodes averaging 5–20 mm, striate underneath the tomentum. Leaves subsessile or petiolate, the petioles to 1 cm long, oblanceolate, obtuse, 4–12 cm long, 1–4 cm wide, membranous, glabrate adaxially, densely short-tomentose abaxially, serrulate to subentire or occasionally closely serrate below, pinnately veined, the midrib prominent. Heads radiate, in large thyrsoid capitulescences. Involucres broadly turbinate, shorter than disk, 7–10 mm high, 5–8 mm wide; bracts 25–35, loosely imbricated in several series, the outer ones with a tuft of loose woolly pubescence at the apex, the inner ones glabrous or sparsely ciliate on the margins, 2–7 mm long, 1–1.5 mm wide, oblong, acute. Ray florets 6–14, inconspicuous, not exceeding the disk, yellow changing to red-purple in age, scarcely bilabiate to ligulate, the ligules to 1.8 mm long, to 0.6 mm wide, the corolla tubes 4–5 mm long, the style branches linear, obtuse, 0.5–1 mm long, stigmatic to apex. Disk florets 15–25, yellow changing to red-purple in age, the corolla slightly ampliate from the middle, 6–8 mm long, the lobes to 0.6 mm long, very sparsely puberulent in the lower portion, the anthers 2.5–3 mm long, the style branches ovate-appendaged, 1–1.5 mm long, the puberulent appendage much smaller than the stigmatic portion. Ray and disk achenes similar, fusiform, 3–4 mm long, to 1 mm wide, canescent, 4-nerved, striate. Pappus of 30–40 scabrous, brown or reddish-brown bristles, 4–7 mm long. Chromosome number, $n = 5$ (Raven, 1963).

Distribution. Sparse populations on rocky canyon walls, San Clemente Island, CA, and Guadalupe Island, Baja California, Mex. (Fig. 1C); associated with species of *Opuntia*, *Galium*, *Artemisia*, and *Heteromeles* at 200–500 m; flowering Jun–Sep.

12. HAZARDIA DETONSA (Greene) Greene, Pittonia 1:29. 1887.—*Corthrogyne detonsa* Greene, Bull. Torrey Bot. Club 10:41. 1883.—*Haplopappus detonsus* (Greene) Raven, Aliso 5:343. 1963. TYPE: In protologue, Greene referred to a “single rigid, leafy branch . . .” at CAS “. . . without a note to indicate whence or through whom it was obtained”. He suggested, nevertheless, that the plant “may have come from some island of the Californian coast long ago”. Fragments at GH, labelled by Greene and dated 5 May 1882, are undoubtedly from this specimen. (Holotype: CAS; Isotype: GH!)

Open irregular shrub 6–25 dm tall, loosely branched. Branches irregular, 1–8 mm in diameter, 1–12 dm long, densely lanate-tomentose, lower woody portions to 3 cm in diameter with tomentum irregularly distributed and revealing light brown bark, leafy to capitulescence, with internodes averaging 5–20 mm, striate underneath the tomentum. Leaves sessile to subpetiolate, subclasping, narrowly ovate to obovate, obtuse, 4–14 cm long, 1–5 cm wide, thick, subcoriaceous, densely short-tomentose adaxially densely lanate-tomentose abaxially, coarsely serrate to subentire, pinnately veined. Heads radiate, in compound, subcorymbose capitulescences. Involucres broadly turbinate to campanulate, 10–13 mm high, 10–13 mm wide; bracts 30–50, loosely imbricated in several series, the outer ones densely lanate-tomentose, the inner ones lanate-pubescent below with a tuft of woolly pubescence at the apex, 4–10 mm long, 1–2 mm wide, oblong, acute. Ray florets 6–14, inconspicuous, not exceeding the disk, yellow changing to red-purple in age, scarcely bilabiate to ligulate, the ligules to 2.2 mm long and 0.9 mm wide, the corolla tubes 5–6 mm long, the style branches linear, obtuse, 0.5–1 mm long, stigmatic to apex. Disk florets 30–40, yellow changing to red-purple with age, the corolla slightly ampliate from the middle, 8–10 mm long, the lobes to 1 mm long, very sparsely puberulent in the lower portion, the anthers 3.5–4.5 mm long, the style branches linear to narrowly ovate-appendages, 1.4–2 mm long, the puberulent appendage much shorter than the stigmatic portion. Ray and disk achenes similar, fusiform, 3–4 mm long, to 1 mm wide, pubescent, 4-nerved, striate. Pappus of 30–40 scabrous, brown or reddish-brown bristles, 6–9 mm long. Chromosome number, $n = 5$ (fide Pinkava on label of *Clark 1061*; Raven et al., 1960).

Distribution. Sparse populations on open rocky hillsides and canyon walls, Anacapa Island (fide Raven, 1963), Santa Rosa and Santa Cruz Islands, Santa Barbara Co., CA (Fig. 1C); often associated with

species of *Pinus*, *Rhus*, *Mimulus*, *Arctostaphylos*, *Ceanothus*, and *Quercus* at 15–300 m; flowering Apr–Nov.

Hazardia detonsa is most closely related to *H. cana* of the southern islands; these have been considered conspecific by several authors (Greene, 1886; Hall, 1928; Munz, 1959). Raven (1963) re-established the specific status of *H. detonsa* and suggested that confusion between it and *H. cana* in the past has been caused by a lack of adequate material of the latter and the extreme variability of the former, due in part to hybridization with *H. squarrosa* var. *grindelioides*.

13. ***Hazardia brickellioides*** (Blake) Clark, comb. nov.—*Haplopappus brickellioides* Blake, Proc. Biol. Soc. Wash. 35:173. 1922.—
 TYPE: USA: NV: Nye Co.: Rocks, Ash Meadows, Sheep Mt., May–Oct 1898, *C. A. Purpus* 6022 (Holotype: US!; Isotypes: NY!, UC!)

Rigid shrub 2–8 dm tall, much branched from hard woody trunk. Branches white-barked, aging to gray, 1–3 mm in diameter, 1–4 dm long, pilose to scabrid, some hairs thickened and tipped with yellow glands, leafy throughout, with internodes averaging 0.5–2 cm, straight to zigzag, angled from leaf margins and midrib downward. Leaves oval, elliptic or obovate-cuneate, acute, 10–35 mm long, 5–25 mm wide, coriaceous, pilose to scabrid, some hairs thickened and tipped with yellow glands, the midrib prominent, the lateral veins less prominent to obscure, reticulate, the apex tipped with a white spine 0.5–1 mm long, the margins dentate with 1–4 pairs of spinose teeth to 0.5 mm long, rarely entire. Heads radiate, solitary at ends of branchlets or in cymose capitulescences with 2–3 heads, peduncles 1–10 mm long from upper axils. Involucres cylindrical to turbinate, shorter than disk, 6–7 mm high, 4–5 mm wide exclusive of the squarrose tips; bracts 15–25, in 4–5 series, lanceolate, 1-nerved, hispidulous and glandular, the tip greenish, squarrose or the inner ones erect, 3–7 mm long, 1–1.5 mm wide. Ray florets 5–8, yellow, inconspicuous, not exceeding the disk, the ligules 2–4 mm long, 0.5–1 mm wide, scarcely toothed at apex, the corolla tubes 4–5 mm long, the style branches linear, obtuse, 0.5–1.7 mm long, stigmatic to apex. Disk florets 8–12, yellow, the corolla slightly ampliate from the middle, 6–8 mm long, the lobes to 0.5 mm long, glandular-puberulent, the anthers 2.5–3 mm long, the style branches linear, 0.9–1.5 mm long, the appendage much shorter than the stigmatic portion. Ray and disk achenes similar, oblong, 2–3 mm long, 1 mm wide, silky pubescent, with 5 white nerves. Pappus of 20–30 scabrous, white to brownish bristles, 5–7 mm long. Chromosome number, $n = 6$ (Anderson et al., 1974; Jackson, 1966).

Distribution. Locally common on rock outcrops and cliffs, limestone mountains, in S Nye and Clark cos., NV, and in the Death Valley region of Inyo Co., CA (Fig. 1A); usually associated with

species of *Atriplex*, *Eriogonum*, and *Brickellia* at 700–2100 m; flowering Jun–Oct.

Hazardia brickellioides was included in *Haplopappus* section *Belpharodon* by Hall (1928), based on the immature heads of the type collection. Jackson (1968) transferred it to section *Hazardia* because of the meiotic behavior of the chromosomes in artificial F_1 hybrids between *H. brickellioides* and *H. squarrosa* var. *squarrosa*. The chromosome number of *H. brickellioides*, $n = 6$, is anomalous in *Hazardia*, but all other characters support its inclusion in the genus.

EXCLUDED NAMES

Hazardia serrata Greene, Pittonia 1:30. 1887. = HAZARDIA DETONSA \times SQUARROSA. [cf. Raven (1963)]. TYPE: USA: CA: Santa Barbara Co.: Santa Cruz Island, Jul–Aug 1886, *E. L. Greene s.n.* (Holotype: ND-G; Isotype: ND-G)

LIST OF EXSICCATA

More than 1500 herbarium specimens were examined during this study. Along with field observations these are the basis of my morphological and distributional data. A list of specimens examined is on file at ASU and has been distributed to herbaria cited below. Additional copies are available on request from the author.

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LITERATURE CITED

- ABRAMS, L. R. and R. S. FERRIS. 1960. Illustrated Flora of the Pacific States, vol. IV. Stanford Univ. Press, Stanford, CA.
- ANDERSON, L. C. 1966. Cytotaxonomic studies in *Chrysothamnus* (Asteraceae, Compositae). Amer. J. Bot. 53:204–212.
- , D. W. KYHOS, T. MOSQUIN, A. M. POWELL, and P. H. RAVEN. 1974. Chromosome numbers in Compositae. IX. *Haplopappus* and other Asteraceae. Amer. J. Bot. 61:665–671.
- BEATLEY, J. C. 1976. Vascular plants of the Nevada Test Site and central-southern Nevada; ecologic and geographic distribution. U. S. Energy Research and Development Administration, Division of Biomedical and Environmental Research.
- CLARK, W. D. and T. J. MABRY. 1978. Systematic implications of flavonoids in *Hazardia*. Biochem. Syst. and Ecol. 6:19–20.
- CUATRECASAS, J. 1970. Reinstatement of the genus *Llerasia* (Compositae). Biotropica 2:39–45.
- DE JONG, D. C. D. and F. H. MONTGOMERY. 1963. Chromosome numbers in some California Compositae-Asteraceae. Aliso 5:255–256.

- DEWET, J. M. J. and J. R. HARLAN. 1972. Chromosome pairing and phylogenetic affinities. *Taxon* 21:67-70.
- DEWEY, D. R. 1974. Cytogenetics of a polyhaploid *Agropyron repens*. *Bull. Torrey Bot. Club* 101:266-271.
- GRAU, J. 1976. Chromosomenzahlen von Sudamerikanischen *Haplopappus*. *Mitt. Bot. Staatssaml. Muenchen* 12:403-410.
- GREENE, E. L. 1886. Studies in the botany of California and parts adjacent. II. *Bull. Calif. Acad. Sci.* 1:179-228.
- . 1887. A new genus of asteroid Compositae. *Pittonia* 1:28-30.
- HALL, H. M. 1928. The genus *Haplopappus*, a phylogenetic study in the Compositae. *Publ. Carnegie Inst. Wash.* 389.
- HARTMAN, R. L. 1976. A conspectus of *Machaeranthera* (Compositae: Astereae) and a biosystematic study of the section *Blepharodon*. Ph.D. Dissertation, Univ. Texas, Austin.
- JACKSON, R. C. 1962. Interspecific hybridization in *Haplopappus* and its bearing on chromosome evolution in the *Blepharodon* section. *Amer. J. Bot.* 49:119-132.
- . 1966. Some intersectional hybrids and relationships in *Haplopappus*. *Univ. Kansas Sci. Bull.* 46:475-485.
- . 1968. Hybridization and classification of *Haplopappus brickellioides*. *Univ. Kansas Sci. Bull.* 47:1005-1012.
- . 1978. Hybridization in *Haplopappus* between sections *Blepharodon* and *Hazardia*. *Abstr. Pap. Meetings Bot. Soc. Amer.* 72.
- KECK, D. D. 1956. *Benitoo*, a new genus of Compositae from California. *Leaf. W. Bot.* 8:25-28.
- KEIL, D. J. and D. J. PINKAVA. 1976. Chromosome counts and taxonomic notes on Compositae from the United States and Mexico. *Amer. J. Bot.* 63:1393-1403.
- MAYES, R. A. 1976. A cytotaxonomic and chemosystematic study of the genus *Pyrrocoma* (Asteraceae: Astereae). Ph.D. Dissertation, Univ. Texas, Austin.
- MCMINN, H. E. 1951. An illustrated manual of California shrubs. Univ. California Press, Berkeley.
- MORAN, R. 1969. Five new taxa of *Haplopappus* (Compositae) from Baja California, Mexico. *Trans. San Diego Soc. Nat. Hist.* 15:150-164.
- . 1976. *Haplopappus enormidens* (Compositae), a new species from Baja California, Mexico. *Phytologia* 34:371-374.
- MUNZ, P. A. 1959. A California flora. Univ. California Press, Berkeley.
- RAVEN, P. H. 1963. A flora of San Clemente Island, California. *Aliso* 5:289-347.
- , O. T. SOLBRIG, D. W. KYHOS, and R. SNOW. 1960. Chromosome numbers in Compositae. I. Astereae. *Amer. J. Bot.* 47:124-132.
- RILEY, R. and C. N. LAW. 1965. Genetic variation in chromosome pairing. *Adv. Genet.* 13:57-114.
- SHINNERS, L. H. 1950. Notes on Texas Compositae. IV. *Field and Lab.* 18:25-32.
- . 1951. Notes on Texas Compositae. VII. *Field and Lab.* 19:134.
- SMITH, E. B. 1965. Taxonomy of *Haplopappus* section *Isopappus* (Compositae). *Rhodora* 67:217-238.
- TURNER, B. L. 1972. Two new species of *Isocoma* (Compositae—Astereae) from North Central Mexico. *Sida* 5:23-25.
- , J. BACON, L. URBATSCH, and B. SIMPSON. 1979. Chromosome numbers in South American Compositae. *Amer. J. Bot.* 66:173-178.
- URBATSCH, L. E. 1975. A systematic study of *Haplopappus* section *Ericameria*. *Abstr. Pap. Meetings Bot. Soc. Amer.* 62.
- . 1978. The Chihuahuan Desert species of *Ericameria* (Compositae: Astereae). *Sida* 7:298-303.
- WATSON, T. J., JR. 1977. The taxonomy of *Xylorhiza* (Asteraceae—Astereae). *Brittonia* 29:199-216.